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Acute Pneumonia Characteristics in Children under Five Years of Age in Bamako, Mali

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Abstract

Pneumonia is the most common cause of mortality in child under five years of age. The objective of the study was to assess socio-demographic and clinical characteristics of children under 5 hospitalized for pneumonia. **Material and method:** We conducted a 6 months prospective study from June 1st, 2016 to December 31st, 2016 in the general pediatric service in the Pediatric Department of Gabriel Touré Teaching Hospital in Bamako, the capital city of Mali. **Result:** We have selected 63 cases of pneumonia according to our definition criteria, *i.e.* 2.2% of hospitalizations for children aged 1 to 59 months. The average age was 14 months. Infants under 2 years accounted for 82.53%. The sex ratio was 1.2. Seventy eight percent came from an unfavorable socio-economic background. The majority of mothers were uneducated (71.42%). Breastfeeding was exclusive up to 6 months in 50.79% of patients. Vaccination according to the national program was not up to date in 27% of patients. The average consultation time was 18 days. On admission, 81% of the patients had a fever, 93.64% had a tachypnea and 58.73% had crackling rales at pulmonary auscultation. Hypoxemia was present in 58.73%. Severe anemia was present in 79.36%. Radiologically, opacity was found in 42 patients (66.66%). The blood culture was positive in 8.3%. Beta-lactams were first-line prescribed in all patients. The case fatality rate was 9.52%. The factors associated with mortality were age less than 14 months ($p = 0.08$), adverse socio-economic conditions ($p = 0.0003$) and the presence of hypoxemia at the entrance ($p = 0.01$). **Conclusion:** Pneumonia remains major cause of morbidity and mortality in our context. Emphasis should be put on preventive measures.

Keywords

Acute Pneumonia, Children, Mortality, Mali

1. Introduction

Pneumonia is the most common cause of mortality in child under five years of age [1] [2]. The annual incidence in the industrialized countries is estimated between 36 and 40/1000 in children under 5 years [3]. Every year, 1.9 million children under 5 die from pneumonia mainly in developing countries [2]. Poor socio-economic conditions, chronic diseases, lack of vaccination, malnutrition, air pollution and inadequate and late care would contribute significantly to high pneumonia mortality [4] [5]. To reduce the mortality attributable to it, the World Health Organization (WHO) has implemented the global strategy for the management of acute respiratory infections in children under five. This is based on early clinical screening and rational use of antibiotic therapy in primary and peripheral hospitals [6].

In Bamako, the capital of Mali, pneumonia was the most frequent cause of hospital admission, representing 18% of total hospital admissions [7]. Acute respiratory infections represent 34% of admissions in children, and 15% of child hospitalizations in the Pediatric Department of Gabriel Touré Teaching Hospital, the national reference structure [8]. However in statistics, there is no information specific to pneumonia.

The aim of the study was to assess socio-demographic and clinical characteristics of children under 5 hospitalized for pneumonia in order to propose preventive measures.

2. Material and Method

We conducted a 6 months prospective study from June 1st, 2016 to December 31st, 2016 in the general pediatric service in the Pediatric Department of Gabriel Touré Teaching Hospital in Bamako, the capital city of Mali. The department is the highest reference structure in the country. Its provides the care of either children referred from all over the country at every level of the national health pyramid or those accompanied by their parents from the city of Bamako and its neighboring areas. The general pediatric ward has 62 beds and hospitalises an average of 2162 patients per year, of which 55% are referred by other health structures [8].

Children over one month and less than 5 years old who were hospitalized for pneumonia less than 14 days old and had a chest x-ray were included.

Operationally:

- pneumonia has been defined according to the WHO in the presence of: cough and/or breathing difficulties, and tachypnea (breathing rate ≥60 cycles per minute in children less than 2 months, ≥50 cycles per minute between 2

and 11 months and ≥40 cycles per minute between 1 and 5 years) [9] [10].

- Radiological confirmation of pneumonia was made according to WHO guidelines [10] [11]. X-ray was blindly interpreted by two radiologists.
- Socio-economic conditions were appreciated with the Chauliac M and Ag Bendech method [12] [13]. This method is based on the residency, type of housing, profession of the child's father, and the family income. This allows us to classify the socio-economic ranking: favorable and unfavorable.
- Vaccination was evaluated according to the Expanded National Immunization Program.
- Severe malnutrition has been defined for a weight-to-size ratio < −3 ZScore [14].
- The diagnosis of human immunodeficiency virus (HIV) infection was made in the presence of a positive PCR-DNA before the age of 18 months or two positive serologies after the age of 18 months [15].
- Anemia has been called severe when hemoglobin <8 g/dL [16].
- Hyperleucytosis has been defined by a white blood cell count > 15,000/mL [16].
- C-Reactive Protein (CRP) was positive for >6 mg/L [16].
- Fever was retained for axillary temperature above 38˚C [16].
- Hypoxemia was retained for oximetry with pulse oximeter 90% [16].

Were not included the children who presented wheezing at auscultation.

The variables studied were related to socio-demographic data (age, sex, socio-economic level, vaccination, pathological history, consultation time), clinical (cough, fever, respiratory distress, respiratory rate, crackling rales), radiological, biological (blood count and CRP), therapeutic and evolutionary. These data were collected using a survey sheet.

Data capture and analysis were done on SPSS version 20. For the analysis of prognostic factors the Fisher Test was used with a significance level of less than 5%.

3. Results

During the study period 2875 children from 1 to 59 months old were hospitalized. We selected 63 cases of pneumonia according to our definition criteria, *i.e.* 2.2% of hospitalizations for children from 1 to 59 months. The average age was 14 months. Infants under 2 years accounted for 82.53%. The sex ratio was 1.2 (34 boys and 29 girls). Thirty-three percent lived in the urban area of Bamako and 78% came from an unfavorable socio-economic background. The majority of mothers were uneducated (71.42%). Breastfeeding was exclusive up to 6 months in 50.79% of patients. Vaccination according to the national program was updated in 27% of patients. A history of congenital heart disease and HIV infection was found in eight (12.69%) and six (9.52%) children, respectively. The main socio-demographic characteristics and antecedents are summarized in **Table 1**.

Table 1. Sociodemographic characteristics and background of children.

Variables	Frequency (n = 63)	Percent
Age		
Average	14 months	
1 - 12 months	38	60.31
13 - 24 months	14	22.22
Sex		
Male	34	53.96
Female	29	46.03
Level of education of the mother		
Uneducated	45	71.42
Primary	16	25.39
Feeding mode before 6 months		
Exclusive breastfeeding	32	50.79
Mixte breastfeeding	25	39.68
Vaccination		
Up to date	46	73.01
No up to date	17	26.98
Medical background		
Congénital heart disease	8	12.69
HIV infection	6	09.52
Psychomotor delay	7	11.11

The average consultation time was 18 days (range 1 to 120 days). The main reasons for consultation were cough (82.53%) and breathing difficulties (58.73%). On admission, 81% of the patients had fever, 93.64% had tachypnea and 58.73% had crackling rales at pulmonary auscultation. Hypoxemia was present in 58.73% of cases. Severe acute malnutrition has been found in 30 children (47.61%). From a biological point of view, severe anemia was present in 79.36%; hyperleukocytosis in 55.55% and an increase in C-reactive protein (CRP) in 60.38% of cases. Radiologically, opacity was found in 42 patients (66.66%). These were alveolar opacities in 32 cases (76.19%). These were bilateral in 19 cases (59.37%) and no pleural effusion was found. The blood culture could be done in 36 patients, it returned positive in 3 cases or 8.3%. The germs found out were: *Haemophilus influenzae b* (one case), *Burkholderia cepacia* (two cases).

The main clinical, biological, bacteriological and radiological features are summarized in Table 2.

Beta-lactams were first-line prescribed in all patients: amoxicillin (61%) and ceftriaxone (39%). They were associated with gentamicin in 39% of cases. The average duration of antibiotic therapy was 13 days (range 3 to 30 days). The average time to obtain apyrexia was 3 days (range 1 to 7 days). The average

Table 2. Clinical and biological characteristics of children.

Variables	Frequency (n = 63)	Percent
Consultation period		
Average	18 days	
Reason for consultation		
Respiratory difficulties	37	58.73
Cough	52	82.53
Alteration of general condition	11	17.46
Clinical signs		
Severe malnutrition	30	47.61
Fever	51	80.95
Tachypnea	59	93.65
Crackling rattles	60	95.23
Hypoxemia	37	58.73
Biological signs		
Severe anemia	50	79.36
High CRP	38	60.31
Leucoytosis	35	55.55
Blood culture (n=36)		
Positive	3	08.33
Négative	33	91.66
Radiological signs		
No	21	33.33
Alveolar opacities	32	50.79
Alveolo-interstitial opacities	10	15.87

hospital stay was 9 days with extremes of 2 and 26 days. Six patients died or a case fatality rate of 9.52%. The factors associated with mortality were age less than 14 months (p = 0.08), adverse socio-economic conditions (p = 0.0003), and the presence of hypoxemia at the entrance (p = 0.01). Table 3 presents the factors associated with mortality.

4. Discussion

This study aimed to determine the epidemiological and prognostic aspects of acute pneumonia in children from 1 to 59 months old hospitalized in a reference last-level service in Mali. The duration of the study could be a limit because it did not allow to appreciate the seasonality of the affection. It took place during the rainy, humid season (June to September) and the cool season between October and December, characterized by dry, cold and dusty winds. As parents were in charge of the X-ray, it was not performed in all patients. That might be one weakness of our work because the hospital frequency was probably underestimated in our study because of this mode of recruitment related to the

Table 3. Analysis of factors associated with mortality.

Factor	Frequency		p-value
	Died	Alive	
Age			
<14 months	06	37	**0.08**
≥14 months	00	20	
Sex			
Male	03	31	0.58
Female	03	26	
Socio-economic conditions			
Favorable	00	44	**0.0003**
Unfavorable	06	13	
Schooling of the mother			
Yes	02	41	0.55
No	04	16	
Vaccination			
Up to date	05	41	0.48
No up to date	01	16	
Tachypnea			
Yes	06	40	0.17
No	00	17	
Hypoxemia			
Yes	06	26	**0.01**
No	00	31	
Positive CRP			
Yes	04	34	0.63
No	02	19	
Severe anemia			
Yes	06	44	0.23
No	00	13	

realization of the radiography. The frequency is lower than those found by Bakonde *et al*. (2.61%) and Guedehoussou *et al*. (5.81%) in Togo [17] [18]. In Tunisia, Tinsa found a hospital frequency of 3.6% [19].

In our series, severe forms of pneumonia predominated in infants under 1 year old (60%). Our results are similar to those obtained by Ouédraogo *et al*. in Burkina and Ibraheem *et al*. in Nigeria, where the group from 0 to 2 years old represented 79.9% and 81.3% respectively [20] [21]. Infants are particularly exposed because of the immaturity of their immune and respiratory systems [19].

It is also during this period that food diversification and breastfeeding decline begin with the risks of diarrheal diseases and malnutrition. It also highlights the importance of protective immunoglobulin in breast milk [22]. The male sex was

predominant in our study. It is considered a factor in the occurrence of pneumonia [23]. Our results are consistent with literature data [19] [21] [22]. This predominance of infants and boys has been asserted by Rudan *et al*. who indicate that about two thirds of pneumonia episodes occur in the first year of life, with a frequency of 1.5 to 1.8 times higher in boys than in girls [4]. The majority of patients lived in an unfavorable environment with mothers who were generally illiterate or poorly educated. A study carried out in Brazil study showed that pneumonia mortality was especially high in rural areas because of the difficulty of accessing health care [24].

In tropical areas with a high malaria endemicity where chronic diseases (malnutrition, anemia, HIV infection) are very common, pneumonia is most often seen in its invasive form. Severe malnutrition was observed in 47.61% of patients. We find similar results in many African authors [19] [21] [22] [25]. Several authors believe that it constitutes fertile ground for the emergence of severe forms of pneumonia [22] [26] [27]. The relative risk of pneumonia in malnourished children is three times higher than in well-nourished children [22] [27], hence the need for nutritional supplementation and routine education of mothers during immunization sessions [28] [27].

In our study, 10% of children were infected with the HIV human immunodeficiency virus. The authors agree that HIV contributes to the emergence of severe forms of pneumonia in children [4] [22] [28] [29]. These children are most often infected with atypical germs and strains resistant to the usual antibiotics [26]. In our study, 27% of children were not properly immunized according to the National Immunization Program. Some authors associate the poor immunization status with the risk factors for the occurrence and aggravation of respiratory diseases in children. According to Ujunwa *et al*., 50% of people with low immunity would have severe forms of acute respiratory infections [22] while Tazinya *et al*. in their analysis did not find a significant association between vaccination and these [22] [28].

Pneumonia is most often manifested through two types of syndromes: infectious syndrome dominated by sudden onset fever, respiratory syndrome with functional signs (cough, dyspnea, chest pain, polypnea) and physical signs (condensation syndrome) [10] [30]. The majority of patients arrived in a chart of tachypnea (93.65%) and fever (80.95%). These serious forms could be explained by a delay in diagnosis and the high frequency of comorbidities, which are very frequent in our context [21] [26].

According to the literature, pneumonia is rarely diagnosed in a patient with normal temperature, heart rate, and respiratory rate [31]. The absence of abnormalities in the pulmonary examination, however, is not sufficient to eliminate pneumonia. Tachypnea is frequently reported in the literature as having a strong predictive value for pneumonia [19] [32]. Several clinical and field studies have shown that tachypnea is the most efficient clinical sign (70%) for diagnosing pneumonia in malnourished children and children under 24 months old [19]

[27] [33]. However, there may be false positives or false negatives and such an approach may lead to overdiagnosis, as demonstrated by an observational study in four Indian hospitals [34]. Therefore, the exclusive use of tachypnea to diagnose pneumonia is not recommended; in case of doubt, a chest X-ray or antibiotic treatment should be prescribed without delay [31] [35] [36]. In clinical practice, physicians generally tend to rely heavily on the presence of crackling rattles while this sign would have a high specificity (79%), but a very low sensitivity (46%) to make the diagnosis of pneumonia [27]. Therefore, its absence would not exclude the presence of pneumonia [27] [31].

According to Fancourt *et al*., 46% of the pneumonia cases defined according to the WHO criteria do not show any radiological evidence of pneumonia [37]. In our study, radiography was normal in 33.33% of cases. Most European guidelines recommend a frontal, inspiratory and standing chest X-ray to confirm any case of severe pneumonia [36] [38]. According to the former French Food Safety Agency (AFSSA) and other studies, there is no correlation between the observed images and the responsible micro-organism [36] [38]. In developing countries it is not easy to use radiography to confirm all cases of pneumonia [35]; WHO recommends it only in case of signs of seriousness, complications, unusual clinical signs, underlying chronic heart or respiratory disorder requiring intensive care, or associated with HIV infection [10]. Most of the symptoms and signs traditionally associated with pneumonia are not discriminating, the search for leukocytosis and the dosage of C-Protein Reactive (CRP) could reduce the abuse of pediatric antibiotics [33] [36] [38]. However, performing biological examinations should not delay treatment [36] and CRP is not useful in the management of simple cases of pneumonia [38]. The value of cytobacteriological examination of sputum (ECBC) is limited because often contaminated by oropharyngeal germs [3] [38]. In a study conducted in Morocco in adults, on the interest of cytobacteriological examination of sputum in the management of bacterial pneumopathies in hospital, it was possible to isolate a germ in only 42.5% of cases [39]. Data from the literature show that viruses, Streptococcus pneumoniae and *Haemophilus influenzae* b are the predominant pathogens in community-acquired acute pneumonia in children <5 years of age [3] [4]. Given the low performance of complementary investigations for etiological diagnosis, a pragmatic approach of therapy with broad-spectrum antibiotics is generally used [34] [36].

Effective management of pneumonia cases is based on appropriate antibiotic therapy and supportive care, particularly oxygen therapy in the most severe cases [3] [40]. Although our practices were not fully in line with WHO guidelines [35], all our patients had received beta-lactams. In our series, the hospital mortality rate was 9.52% while it was only 0.8% in Brazil [24]. Factors associated with mortality were age less than 14 months ($p = 0.08$), adverse socio-economic conditions ($p = 0.0003$) and presence of hypoxemia at entry ($p = 0.01$). In the study of Nascimento-Carvalho *et al*. in Brazil, the deaths of children with pneu-

monia had occurred on a comorbid ground: cardiopathy, neuropathy, asthma, gastro-oesophageal reflux, congenital infection, hypothyroidism [24]. These pathologies have a negative influence on both the symptoms, the prognosis and the cost of treatment [24] [32] [35]. Reducing hospital mortality with pneumonia then requires continuing education of care staff for proper case management, improved access to health care and efforts to educate mothers about health

5. Conclusion

Pneumonia remains a major cause of morbidity and mortality in our context. The adverse socio-economic conditions favoring the non-respect of preventive measures such as vaccination and the late use of care, constitute a key prognostic factor. Further work should examine the determinants that the authorities could act to reduce the frequency of pneumonia and the deaths attributable to it.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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